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GEOLOGY AND TOPOGRAPHY

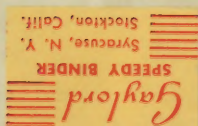
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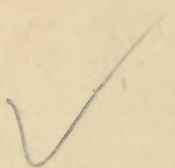
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GEOLOGY AND TOPOGRAPHY OF IOWA
IN A
SANITARY POINT OF VIEW.
PREPARED BY
P. J. FARNSWORTH, M. D.,
FOR THE
IOWA STATE BOARD OF HEALTH.



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GEOLOGY AND TOPOGRAPHY.

THE GEOLOGY AND TOPOGRAPHY OF IOWA IN A SANITARY POINT OF VIEW.

BY P. J. FARNSWORTH, M. D., CLINTON, IOWA.

The geological and topographical features of a country determine, in a great measure, its sanitary conditions or capabilities. They characterize the soil drainage and water supply, the temperature, moisture, and other qualities of the air, and the kind and quantity of the productions. They are, therefore, important elements in the consideration of the health and prosperity of a State, and merit a careful study. A subject so extensive requires a large collection of facts, some of which are accessible, others are yet to be obtained. We can, therefore, only treat it in a general manner. We can glance at primitive conditions and draw some probable conclusions from them; but a more extended record of observations must be made to determine the effects of added settlement and cultivation.

If we go back for a period of a little more than fifty years, the Territory of Iowa was in a state of nature; it had primitive soil and virgin prairie. It then became open to civilization, to men who dispossessed the nomadic Indians and the roving buffalo, who were to cultivate the earth, build towns and cities, and render their surroundings sanitary or unsanitary, as their knowledge or ignorance prompted them. In fifty years the whole State has been brought under cultivation, the face of nature changed, the soil upturned to the sun, the marshes drained, trees planted, and the vegetation altered. How far the natural surroundings are affected by artificial conditions must be determined by facts in process of accumulation. We are to consider the natural features, the geology and topography, and their relations.

Iowa is a part of the great inter-continental plain or plateau of North America. In shape it is nearly a parallelogram; its northern boundary is $43^{\circ}, 30'$, north latitude; its southern, $40^{\circ}, 36'$; its eastern and western boundaries are the two great rivers of the continent, on the east touching $90^{\circ}, 30'$, west from Greenwich, and extending to

inclination. Two thirds of the rivers of the State flow to the south-east, in nearly a parallel direction and fall into the Mississippi. See Fig. 26.* A line of elevation runs across the State, west of the Des Moines river, and nearly parallel with it, making a water-shed to the southwest toward the Missouri. There is, however, but little deviation from the general prairie level over the whole State. The river valleys vary in width, and in most places are bordered with abrupt banks or bluffs.

Over the drift is a thick layer of humus that has been accumulating for long ages. Along the banks of streams where the soil is thin and grass does not grow luxuriantly, trees are found; also they grew in isolated groups and in a scattered condition. Nothing like a continued forest exists, except in some of the river valleys, and these not very numerous.

The drift material came from a region to the north and northeast. It is composed of the disintegrated Devonian rocks, and of a cretaceous formation. This cretaceous stratum is in place, in a portion of the northwestern part of the State, and extends to the upper waters of the Missouri; its debris is found in a large portion of the soil of the State. From it is derived lime, magnesia, potash, and soda; lime, and magnesia in large quantities. These affect all the wells and springs found near the surface or in the drift. The sulphates and the chlorides of potash and soda appear in many places to a limited extent. At some remote period all the marshes and shallow lakes must have been strongly alkaline.

The soil of most of the western water-shed affords some striking peculiarities. It is homogeneous to a great depth and is denominated a lacustrine formation. At some time a deep valley existed which became a lake and was filled with sediment, the wash of all that great northwest which make the Missouri the "big muddy," and of which some observer remarks if it had been turned into Lake Superior would have filled it and all the chain of lakes with solid land.

It consists of clay, sand, lime, and other alkalies and vegetable matter, and makes a fertile soil when thrown up from hundreds of feet below the surface.

Nearly all the water used for domestic purposes comes from shallow wells. Springs occasionally are found, and some of the larger towns are beginning to draw their supply from the rivers. Wells are

* This cut is used by permission of Mills & Co., publishers of White's Geology of Iowa.

yet the main dependence for farm houses, towns, and cities. They are from ten to fifty feet deep. The sub-soil holds the necessary supply, and the ground-water is near the surface. All are contaminated with the salts of lime, and some with magnesia and the sulphates, and chlorides of potash and soda. All the waters of rivers, lakes, and springs are hard. This does not seem to be a source of ill-health, so far as yet observed. It sometimes temporarily affects newcomers, but this is soon overcome.

It has been observed in European countries that the strongest conscripts come from the hard water districts. The deep layer of humus, and the organic material of the drift may contribute more objectionable elements to the potable waters. The ponds and streams, beside containing lime and other alkalies, are contaminated with organic matter, more than cleanly kept wells. Settlement and cultivation add pollution to the streams, and contamination to the wells; for the soil is not of a character to thoroughly filter out impurities; therefore, special precaution must be used. In some places wells are drilled into the underlying rock, but this is of a porous nature, and admits surface water; and is itself largely dissolved by the water that penetrates it.

Ground or surface water exists at a little depth over all the State; there being no season of great dryness that evaporates it, but often there are rainy seasons that keep the soil saturated all the year. In other words, the soil of all the country may be classed as a moderately damp one.

The cause of ague, or periodic fever has in all ages been a fruitful source of discussion. Miasm, or malaria, a poison generated in certain soils by heat and moisture, entering the system to produce a specific result. Whether it is a poison that accumulates in the blood, or a multiplying bacteria, a bacillus, or a microgerm, is not essential to the present subject. The fact remains that some cause of special fever prevails over all the State. It arises in seasons of great heat and moisture, and is not confined to any locality, but affects all the State. Certain soils may be better for its development than others, and it may be denser in certain localities, yet owing to there being no ranges of hills or mountains, and no continuous forests, the winds equalize it over the whole land.

This general diffusion only happens at rare intervals, yet in every part of the State, in any season, few diseases occur that do not mani-

fest symptoms of this poison, and require antidotes that counteract it. Cultivation of the soil and general drainage may diminish or destroy it; they have not yet done so to any extent.

As our State is only a portion of the great plains, where like conditions exist, it will require more extended sanitation, beyond our borders, before the malady will be obviated, or cease to make its appearance among us.

Turning up the soil to the sun, drainage of surface and sub-soil, and the growth of trees, are the remedies that are to be applied for its extinction.

The greater portion of the State was destitute of trees. They grew only in thin soils and along water-courses. The reason for this may have been in the early condition of the surface, covered with shallow water, often alkaline, then covered with grass and herbage that afforded material for annual (spring or autumn) fires. Trees grow in the upland prairie luxuriantly, when planted and protected, but when exposed to the fires that used to prevail, none took root, or if rooted did not survive. There are dry periods every year after vegetation has ripened, or been killed with frost, when a fire once started spreads far and wide. These dry periods may have been longer in past times, as there are evidences that the rainy belt is extending farther west at present. It is very conclusive to any one who has observed prairie fires, that this is the reason the prairies were treeless.

Geologists are proving the existence of man even before the glacial or ice period. He was always a fire-using animal, and it is probable that for sport or by accident he started the annual burning that kept down the forests.

Notwithstanding the destruction of the timber found in the country when first settled, tree culture is becoming a part of agricultural work, and groves and ornamental trees meet the eye in every direction where once it was only a sea of grass. This must in time produce a beneficial change in the climate and health of the State. It is shown that destroying the forests of a country increases the severity of its climate, and contributes to its barrenness, so the cultivation of forests in a fruitful but treeless country, must improve the purity of the air, mitigate its heat and cold, and regulate its moisture.

The Mississippi river running along the eastern border has a valley or flood plain from two to eight miles in width. In the lower part of the State it is one hundred and fifty feet below the level of the prairie,

increasing in the upper part to four hundred. The banks are abrupt, and in many places precipitous. If soil is afforded, they are covered with trees and a flora differing from the prairie; this is also true of the trees of the bottom. Some of the largest cities of the State are built in this valley and on the adjacent bluff. The temperature and rainfall is not appreciably different, but the force of certain winds are broken.

The soil of the plain is an alluvium resting on a drift-clay, this resting on the rock which for the greater part of the river course is a soft magnesian limestone. The wells are dug in the clay or sunk into the porous rock.

Most of the other cities of the State are built in river valleys where nearly the same relations of humus, alluvial matter, clay and rock exist, except that on the rivers of the interior and the Missouri, the rock is at a great depth.

The larger cities are beginning to draw their water supplies from the river, but shallow wells are in a great part depended on, and will be for some time to come.

The valleys of the Mississippi and Missouri are subject to occasional overflows. This occurs in April, May, June or August; sometimes in September or October. These overflows are not regular but occur with intervals of from three to ten years. The period of high water usually lasts from five to ten days. No special disease or epidemic has been observed to follow these inundations. The rank vegetation of a fertile soil soon covers the ground in spring or summer after the water subsides, and absorbs the moisture; in autumn the frost destroys it.

The drainage of the river valleys is difficult; the cellars are uniformly damp, if not actually filled with water for the greater part of the year, owing to the proximity of the ground water; this is true of the cellars in prairie towns and in farm houses. It undoubtedly is a cause of disease, and especially may have to do with one that, though not very prevalent, is becoming much too frequent, consumption. From a limited observation it seems much more common than in the early history of the State. Dr. Bowditch, of Massachusetts, and Buchanan of England, have proven the relation of consumption to ground-water or soil dampness. They have shown that consumption is greatly decreased in certain localities where efficient drainage has been introduced, and that "there is a certain connection with the frequency and

mortality from phthisis and a damp soil." "Additional evidences," says a late writer on hygiene, "from different parts of the world has confirmed the conclusion that dampness of soil is an important cause of phthisis to the population living upon the soil."

Twenty years ago the writer settled in a city in the valley of the Mississippi, and in a radius of twenty miles never saw or heard of but one case of consumption for eight years. From that time until the present, cases have been known each year, until it has amounted to as many as ten, in some of the later years. This is believed to be true of other parts of the State. There has been no marked increase or decrease of other diseases in that time so far as observed.

Other factors are to be taken into account, such as difference in the modes of life, increase of population with hereditary tendency to the disease, advance in time of life—all are not sufficient to account for the increase in tubercular disease.

As a matter of limited experience in regard to soils, it has been observed that a tract of alluvial land is a locality of frequent malarial disease. The probable explanation is, that the same contains a large amount of organic matter, and that impurities that fall on the surface penetrate to some distance, the water flows away and leaves them, instead of being carried away by surface drainage, as on an impervious soil.

The prairies are nowhere entirely flat, but are in swells, like the waves of the sea. This leaves many depressions that hold water and make shallow ponds or "sloughs," that are permanently or temporarily filled with water. They contain the waters drained from the surface after rains or melting snow. In a few places there are ponds or small lakes of sparkling water, but most of them are susceptible of drainage, or dry up during the heat of the summer. They contain a large amount of organic matter, and are the source of miasm. They would be much more so if the coarse grass that springs up did not absorb it to a great extent. There are few marshes or sloughs in the State that are not susceptible of drainage, as they are not fed by springs. The advance of settlement has brought most of these tracts into cultivation.

The climate of the State is modified by its position; a central portion of a great plain that has a gentle incline to the south; in the heart of the continent. The plateau extends from the eastern base of the Rocky mountains—perhaps it would be better to say from the

lower summit instead of the base; for if we pass west it is a gradual and almost imperceptible ascent until we attain 7,000 or 8,000 feet. The State at the southeast corner reaches near the lowest part of the plain, which then ascends to the east to the foot of the Alleghenies.

The isothermal line passes across the State diagonally, advancing to the northwest. It is in a measure protected from the storms of the Atlantic, and is far enough from the mountains that intercept the moisture from the Pacific to receive a due amount of precipitation. Its winters are usually mild; spring opens early enough for the planting and propagation of all the grains and fruits of the temperate zone; a hot month or two of summer follows, then the mild, hazy weather of autumn is sometimes prolonged until December. Moderate snows fall during the winter, the cold is seldom intense, the rainfall and moisture is pretty evenly distributed; general or long continued drouth is never experienced.

The moist wind comes from the northeast over the great lakes and up the valley of the St. Lawrence. The dry currents, or wind of precipitation, comes from the northwest from a cooler latitude, and over the dry plains. Winds blow from other directions. A gusty, cold wind blows in winter and spring from the northwest that is denominated a blizzard. It is a very absorbing wind, and, aside from its discomfort, must purify the air and leave it healthful. Gales and tornadoes sometimes visit the State from the southwest.

Observations on meteorology have been made in various parts of the State for a series of years. A general uniformity of temperature prevails, local storms arise, and moisture is sometimes unequally distributed. The average temperature has varied less than a degree for a period of forty years from January to the end of December; in two or three localities the yearly average of three daily observations is 47½ degrees, not varying a degree in any year.

Frost comes the last days of September or the first weeks of October. Snow falls in November, the Mississippi freezes over the first of December, the coldest days are about the first week of January. Spring opens in March, hot weather commences in June and is most intense during July. A cool wave passes over the State the last days of August or first of September. The mild hazy Indian summer weather begins in October.

This may be called the average climate; in thirty years there have been a few exceptional seasons. Three times within that period the

winters have begun in November, extreme cold occurring in January, with heavy falls of snow. For several days together the mercury has fallen to from 20° to 30° below zero. Two or three feet of snow has fallen and remained in drifts where the winds piled it until the middle of April.

On the other hand, in the same period have occurred winters in which very little snow fell, and the ground and the rivers were unfrozen in January, and spring opened by the first of March.

The mercury rises to 95° in July but seldom more than a degree or two above that. One of the oldest observers in the State makes the remark that he has never seen the mercury rise above 98° in the hottest day or fall below 36° below zero in the coldest. A cold winter is followed by a hot summer.

The rain-fall is much more variable and modifies the heat of summer, and determines the prevalence of certain diseases. Rainy and snowy belts and local storms are sometimes observed. Dry cold weather, except as a general depressing agent, is healthful; dry hot weather is also sanitary; but when cold and dampness occur lung diseases prevail, when moist hot weather occurs in the after part of summer, malarial fevers and summer complaints of children are frequent or epidemic.

A cold winter, followed by a damp cold March happens in exceptional years, not as a rule, and there results a large mortality among aged people, and those predisposed to consumption. During three or four summers in twenty years, rain has fallen during the month of August, accompanied with hot weather. Malarial fevers have been epidemic, and the mortality among children very great.

This subject of meteorology is to be left to others, and the relation of climate to disease is to be determined when the board have obtained the necessary statistics.

Local causes will then be found as the origin of many diseases.

Geologically considered the State rests on a formation of magnesian limestone. This is covered for the most part conformably, with a drift deposit varying from two to three hundred feet, of an argillaceous character. It contains the remains of a formation similar to that on which it rests, and also of a cretaceous strata, and contains considerable vegetable matter. Over this is a deep layer of humus. The clay sub-soil contains a large amount of lime, and its salts affect the water found but a little way below the surface. The water for

domestic purposes is hard, and sometimes contaminated with other salts than those of lime, and with organic matter. The proximity of the ground water makes the habitations damp. People become accustomed to the use of hard water, and it is not known to be the source of any disease. It is easily polluted, but that is an artificial result, and not to be considered here.

The dampness of soil may originate phthisis and aggravate other complaints. The organic matter of the superficial soil generates miasm. These are the most obvious points of the geology and the sanitary condition connected with it. Topographically, the country is part of a great plain in the interior of the continent, inclined to the southeast, equally exposed to the sun and wind. It has universally the same dampness when the moist current comes, and the same dryness when the dry winds blow, as there are no hills nor mountains nor forests to deviate storms or epidemics.

The rivers flow in valleys of erosion, many of them worn deep through the drift into the underlying rock.

The facilities for drainage are good, except in some of the river bottoms, where towns are located, there not being elevation sufficient to escape the flood tides. The climate is but little modified by the topography, being subjected mostly to influences beyond the State, it being part of the great intercontinental plain open from Hudson Bay to the Gulf of Mexico, bounded by the distant mountains along the Atlantic on the east, and the far off Rocky mountains on the west. Its central position gives it a medium climate, favorable for fruits and grains of the latitude, and also favorable for health and longevity.





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